ELECTRON-ION COLLIDER DETECTOR ADVISORY COMMITTEE

Report of the 10th Meeting held on Thursday and Friday, 28 – 29 January, 2016

BNL, in association with Jefferson Laboratory and the DOE Office of Nuclear Physics, has established a generic detector R&D program to address the scientific requirements for measurements at a future Electron Ion Collider (EIC). The primary goals of this program are to develop detector concepts and technologies that are suited to experiments in an EIC environment, and to help ensure that the techniques and resources for implementing these technologies are well established within the EIC user community.

The EIC Detector Advisory Committee met at BNL on January 28 – 29, 2016. The Committee members are: M. Demarteau (ANL/Chair), C. Haber (LBNL), P. Krizan (Hamburg), I. Shipsey (Purdue/Oxford), R. Van Berg (U. Pennsylvania), J. Va'vra (SLAC), G. Young (JLab). Peter Krizan was unable to attend the meeting due to a conflict with a review of the Belle experiment in Japan. Progress reports were submitted before the meeting and were evaluated by the committee. One Letter of Intent was also heard. At the previous meetings the committee suggested that those R&D groups with similar research topics form research consortia to make the overall program more efficient. The committee is pleased to note that the eRD3 collaboration plans to join forces with the eRD6 consortium.

The long-range plan of the Nuclear Physics Science Advisory Committee was released in October of last year and Thomas Ullrich summarized the main elements of the report and the next steps the community plans to take. The NSAC subcommittee has ranked the high-energy, high-luminosity polarized EIC as the highest priority for new facility construction following the completion of the Facility for Rare Isotope Beams (FRIB). A related initiative was formulated that recommends a vigorous detector and accelerator R&D program to develop tools and techniques that are state-of-the-art or beyond for the EIC to achieve a US leadership role in nuclear physics. Targeted detector R&D for the EIC is considered to be critical to ensure that these exciting scientific opportunities can be fully realized. The committee enthusiastically welcomed this news. A review by the National Academy of Sciences, expected to take about 18 months, has already been initiated, and CD-0 for the project is expected shortly afterwards. Thomas Ullrich also noted that an EIC User Group has been created to collaborate and to enhance and refine the science case, beyond that which has been presented in the EIC White Paper. This will serve to help define and coordinate the research equipment, including the necessary detector technologies and designs required to achieve the scientific goals of the EIC and to effectively engage with other stakeholders to turn the EIC into a reality. The EIC Users Group met for the first time January 6 – 8, 2016 in Berkeley.

General Remarks

The proponents are to be congratulated on the generally good quality of the talks, the focus of the work reported, and on the efforts to obtain the many results presented. The reports demonstrated in most cases responsiveness to prior charges and comments as well as ongoing dialogue among proponents of similar technical solutions. The committee would like to thank the proponents in their efforts to make the review process effective and for following the advice given in the previous report. The increase in the number of publications is especially welcomed and all proponents are strongly encouraged to continue to publish their results preferably in peer-reviewed journals, but at a minimum on the archives. Many collaborations have been in existence already for many years and the number of publications does seem to be lagging.

The committee anticipates that, with the endorsement of the EIC as the next highest priority construction project for the nuclear physics community and the support for advanced technology R&D, there will be a substantial increase in the number of proposals to be considered at the next meeting while the funding is not expected to increase before FY17 at the earliest. The committee has a fiduciary responsibility to evaluate all proposals fairly. All existing R&D groups are therefore strongly encouraged to more crisply articulate their R&D program with achievable milestones for key performance parameters and prioritize their research program.

The committee would like to reiterate that the intent of this R&D program is to provide seed funding for promising research ideas that after a couple of years will migrate to base support funding. With the endorsement of the EIC as the next high-priority construction project of the Office of Nuclear Physics there is an opportunity for all proponents to engage the Office in considering new Field Work Proposals. We suggest that the proponents start to consider capitalizing on these new opportunities.

eRD1: Calorimetry for the EIC

C. Woody reporting

The report addresses work on the tungsten powder-fiber calorimeter development at UCLA and at BNL with various collaborators, and the new beginning effort to characterize PbWO crystals from different sources led by the Catholic University of America (CUA) and the Institute de Physique Nucléaire (IPN), Orsay. There are also results reported from calculations and measurements both of the expected radiation fluences, for ionizing radiation and separately neutrons, for an experiment at the EIC and for the existing STAR and PHENIX experiments, with implications for readout technology choice for a calorimeter being discussed.

The W-fiber effort has resulted in construction of several test modules with fiber-supporting grids set up to be 1- or 2-D projective. The committee notes that the studies were carried out for sPHENIX, which has little relevance for an EIC environment. No justification has been presented for a choice between these two configurations for an EIC environment. The committee notes that similar studies were carried out for HERA and requests a summary of the conclusions of these studies at the next meeting. Different methods of grid production and polishing, and comparison of grids to wire harps were done. The fiber claddings are preserved in good condition during assembly using these techniques. Good fiber placement and alignment can be achieved, with some considerations for good fiber-end support remaining in some geometries. Packing of the W-powder using centrifugal and vibrational methods was tried, with densities of 10 g/cm^3 achieved for the centrifugal method and some 7-10% lower for the initial vibrational trials. Light yield measurements of fibers were made for various treatments of fiber ends, locations along the fiber bundle, end-covering types and surface treatments, and types of light guide. Light yield measurements for radiation-hard 3HF fibers were made, with somewhat disappointing results on light yield, measured at 22% of the usual SCSF78 fibers. Simulations of energy resolution for a geometry with larger sampling fraction and fiber light yields were carried out and shown to reach the desired 6-7%/$\sqrt{E}$ range that will be needed for the central and hadron-going directions at an EIC. The radiation doses and damage have been both simulated and measured in a few cases and now motivate discussion of readout technology, particular in the forward region of the hadron-going direction, where for example APDs may need to be considered instead of SiPMs. Circuitry for SiPMs is developed, including compensation for the increase in dark current with accumulated dose and stabilization of temperature, both known needed components. Beam time has been obtained at FNAL to carry out further in-beam tests and measurements of position and energy resolution as well as electron/pion discrimination.

The Committee takes note of the considerable level of effort in this area. Effort to determine radiation doses for various rapidities and implications for readout choice, and further prototyping followed by measurement using the proposed revised fiber shapes, sizes and sampling fractions, are of interest. Focus is suggested on the occupancies to be encountered at an EIC in order to inform the geometry choices for the calorimeter. The Committee is interested to see this effort reach a demonstration in the next 6 – 12 months of a device, which demonstrates the needed energy and position resolutions for an EIC detector, while preserving the manufacturability demonstrated and the fiber and tungsten supply sources developed to date.

The work on crystal PbWO calorimeters was begun and focused on obtaining some new modules from Crytur, characterizing existing crystals and new ones from BTCP, SICCAS and Crytur, and initiating construction of a prototype matrix of crystals. It is encouraging to see receipt of crystals from Crytur, which is an important component of establishing a source of good quality PbWO for future projects; the Committee is pleased to see the development of relations with the PANDA effort via U. Giessen and the NPS effort at JLab. Results from a number of efforts and types of measurements at CUA, IPN and California Institute of Technology (CIT) to measure crystal longitudinal and transverse light transmission, scattering, and light yield were presented. The CIT facility is well established, and the Committee takes note of the effort to establish capabilities at CUA and IPN, which would be available over the coming years to participants in the EIC experiments.

Development of this methodology in order to lead to the establishment of a standard set of reference measurements to be carried out for each crystal is encouraged. A standard reference measurement using transverse cosmic rays or radioactive sources to establish light yields will also be useful. The light yields quoted are adequate to reach the stated resolution goal of $2\%/\sqrt{E}$, however the specific numbers reported point to the importance of very good light transport from the crystals to the photo-sensors and the consequent importance of the design of the light guide used; this could be an area for future measurement and development. Estimates should be made of expected radiation damage over ten years of operation, the resulting loss of light yield, and the deduced initial light yield needed to be able to preserve good resolution over the life of the experiment. This could also be of use to establish the amount of crystal-to-crystal variation that could be accepted in a production run.

The entire calorimeter consortium is encouraged to bring the R&D closer to the environment of the EIC and develop a closer correspondence of the ongoing R&D and the physics goals of the EIC, if possible within the context of a detector concept. For example, the needs of the rapidity range over which the excellent energy resolution of crystals is required, and when the energy/momentum resolution task could be taken over by a tracking system (e.g. in the central and hadron-going directions) and the calorimeter's role in those regions thus focused more on electron isolation and identification could be studied. This would be helpful in establishing the scale of a crystal calorimeter needed for the EIC.

eRD2: Magnetic Field Cloaking Device

N. Feege reporting

The collaboration reported further work on magnetic shielding measurements using the high-Tc tape wound devices reported at the previous meeting. The capability to shield a forward dipole field, that is used to enable tracking at very forward angles without creating momentum dispersion for the primary collider beam, remains compelling.

The devices tested include the multi-layer superconducting shield and measurements over lengths of 1 meter involving several external magnets of strengths from 50-70 mT. It is encouraging to see the shielding counteract all the longitudinal variation of the external field that was introduced.

It is unfortunate that neither the in-beam tests nor the tests in a magnet of strength circa 0.5T could be started.

The Committee encourages the leadership of this effort to consult as soon as possible with the needed management at BNL or perhaps JLab or other laboratories to obtain access to a 0.5T operating magnet in order to carry out the proof-of-principle tests needed for the shielded tubes. An existing AGS conventional dipole with power supply might be found whose gap could be adjusted and whose field could be oriented horizontally to accommodate a Dewar holding the coil of interest. The tests at Helium temperatures may require outside assistance in locating a suitable Dewar or existing cryostat to allow cooling to such temperatures and doing such tests at a laboratory having a helium liquefier. The Committee notes that a Dewar of a possibly suitable length was used at MSU FRIB some three years back to test a coil (for the Hall C Horizontal Bender septum dipole) by immersion in liquid helium. The committee looks forward to completion of these measurements by the next meeting and these results being prepared for publication.

eRD3: Fast and lightweight EIC integrated tracking system

B. Surrow reporting

The group is working on both forward GEM (in collaboration with RD6) and barrel MicroMegas tracking solutions for an EIC detector. The bulk of the MicroMegas work is going on at Saclay while most of the GEM work is being conducted at Temple.

The Barrel MicroMegas work at Saclay is strongly coupled to the construction of the barrel detector for CLAS12 and benefits from that synergy. Testing of the ID MicroMegas barrel detector with cosmic rays continues. The Saclay group also has designed a new VFEB to allow remote location of the DREAM chip (to lower the material budget). A forward GEM quarter section prototype from Temple is now under cosmic ray testing at Saclay using the new electronics and very preliminary results are promising, but work remains to produce a fully convincing analysis and measure efficiency across the surface of the segment.

The development of a commercial source of GEM foils continued and new foils were delivered recently and are undergoing QA/QC testing at Temple. A larger optical QA/QC setup is under design at Temple to handle larger foils (up to 1 meter in length), which would be suitable for a full sized EIC forward detector. The commercial source of high quality foils is not ready to commit to an upgrade that would allow the manufacture of 1 m scale foils, however, without indications of a viable market. At the moment, only the CERN prototype shop is capable of fabricating 1 m scale foils and is already committed to supplying all the needs for the CMS and ALICE upgrades – this leaves the viability of a second, commercial, source uncertain.

In collaboration with RD6 (Temple, Florida Institute of Technology (FIT) and the University of Virginia (UVa)), a full sized triple GEM foil design was completed but, because of size limitations at the commercial vendor, may need to be scaled back to order 50 cm to allow production of foils for prototype chambers in the near future – the committee encourages this course.

Temple is also finishing the construction of a 40 cm scale multi-gap GEM chamber which will be outfitted with the new electronics (DREAM chip) and tested using cosmic rays. The committee looks forward to interesting results from this test program.

eRD6: Tracking Consortium for the EIC

K. Dehmelt reporting

eRD6 is working on a variety of tracking solutions for an EIC detector. eRD6 has functioned well as a real consortium and is viewed as a central effort among the various EIC R&D projects. The collaboration has aggressively pursued a successful test beam program and has a good record of publication and training.

At the time of the July 2015 review, the committee noted that "the design of a "Common GEM Foil" that can be used by the different groups at Florida, Temple and University of Virginia in different configurations to study various issues such as frame design and assembly techniques promises to be of significant value." As reported here, that foil has been designed and is ready for fabrication at the CERN printed circuits facility.

The committee recognizes that focused R&D efforts may sometimes rely critically on the contributions of one or a few key people. In this case we understand the needs of the Florida Tech group to continue to support their post-doc Dr. A. Zhang. This is noted and will be taken into serious consideration at the summer 2016 review when we next allocate funding for the EIC R&D.

The eRD6 collaboration has been creative and innovative, in a number of regards, in pursuit of higher performance (resolution, radiation length etc.) There is often a balance to maintain between direct experimentation and preliminary analysis. In this regard we offer the following comments/questions.

With regard to dropping the "thick" copper layer on the foils, in favor of just the thin chromium base layer, the committee would have liked to see more analysis of this option first. Has this option ever been considered before, somewhere else? Is it dealt with in the literature? The resistivity of chromium is nearly 8 times that of copper. Considering also the thickness reduction, what role will this play in the impedance of the foil and its time response? How robust is a thin chromium foil to breakdown?

With regard to the interleaved hexagonal pad design, there are also a number of basic questions, which precede fabrication and measurement. This configuration offers better resolution but at higher source capacitance and cross talk. The characteristics of the front-end readout electronics, in particular the preamp, will therefore be important here if you want to maintain or reduce the noise levels. Have you done a system analysis of this new configuration in comparison to the original simple design? The configuration has regions of solid hex pads as well as interleaved regions. For charge in the solid regions 100% of the signal goes to one preamp while in the overlap region the charge is shared between two inputs. Therefore the S/N will be affected, in addition to source capacitance issues. So, like the zig-zag design, we would expect a varying resolution. Has this been considered already?

The committee notes the challenges of the TPC/Cerenkov project and looks forward to seeing a demonstration of the use of this technology for an EIC application and the test beam results later this year.

eRD12: Polarimetry, Luminosity and low Q^2 tagger for the EIC

R. Petti reporting

The Committee was pleased to hear of the progress in developing a high-quality polarization measurement program that is essential for the physics exploitation of the EIC. At our July meeting we encouraged the proponents to proceed with the simulations for the design of a Compton Polarimeter at the EIC. Much of the work has been completed. This includes a literature search of existing and planned facilities that use electron polarimetry, writing a Monte Carlo Compton event generator, and code to analyse the Compton events to extract the asymmetry. The proponents have also performed studies to determine the statistics needed to achieve a 1% polarization measurement. These simulation studies will lead to a full design of the polarimeter.

The proponents have developed a plan for the placement and detector geometry for the luminosity monitor, low Q^2-tagger, and electron polarimeter. They have also included roman pots as a forward proton tagger that was not part of the initial proposal. The work continues in conjunction with the machine development to determine a solution that will meet physics goals.

In the next six months in addition to completing the polarimeter studies (transverse polarization measurement, laser requirements), the simulation studies will be refined to more carefully consider backgrounds. The committee looks forward to the completion of this study by our next meeting.

eRD14: Integrated particle identification for a future EIC

G. Kalicy reporting

The committee recognizes that this consortium was formed with our encouragement and is very pleased with the progress the four groups studying particle identification for the EIC have made over the course of the last year. It is noted that all research projects within this consortium are applicable to an EIC detector concept. The committee would appreciate a review at the next meeting of the technical challenges in particle identification for the EIC and how the R&D carried out within the consortium moves the state of the art forward. Formulation of a set of key performance parameters that will satisfy the physics specifications for an EIC detector and how the projects mesh with the proposed EIC detector concepts would be appreciated.

Modular Aerogel and Dual-radiator RICH

- The modular Aerogel with a Fresnel lens RICH or Dual-radiator RICH may be good concepts for the forward direction.
- The real question is how to make pixilated single photon detectors. UV transmission of a Fresnel plastic lens precludes using a CsI photocathode on GEM foils. If GEMs are used, a new photocathode has to be developed. One could consider Hamamatsu HAPD detectora as used in Belle-II Forward RICH. This type of detector may work at 3T. Or, perhaps, Photonis XP85122 1024-pixel MCP-PMT with Bialkali photocathode and 10 μm pores. One can configure this tube to pixel sizes one would need. A tube along this line, either made by Photonis or the LAPPD collaboration, might actually work. One has to do a study in high magnetic fields. However, according to Lehmann's study (NIM, A595(2008)173), published some time ago, a 10 μm tube would just about work with a gain of a 2-3x10^4 at ~3T.
- To demonstrate the Modular Aerogel RICH concept in a test beam with MaPMTs is fine, but it does not solve the problem of photosensors.
- We support a simulation effort to optimize variables such as number of photoelectrons per ring, pixel sizes or optimal geometry.
- Radiation hardness of plastic Fresnel lens should also be investigated.
- The committee would like to see future milestones for the next year of R&D presented at the next meeting.

DIRC

- The committee sees progress in both the simulation and experimental effort. We hope to see a detailed comparison between MC and test beam data by the next meeting.
- Presently the single photon resolution of lens-based optics is worse than the FDIRC or BaBar DIRC resolutions (preliminary Panda test beam results give: ~13.5 mrads vs. FDIRC & DIRC: ~10.5 mrads at 90 deg). Clearly, understanding of this discrepancy, and studies of other variables such as number of photoelectrons per ring, shapes of Cherenkov signal and background, and S/N ratio are essential. We hope to see this by next meeting. One should note that EIC DIRC design aims for 6.8 mrads for 3mm pixel size.

- Poor single photon Cherenkov resolution at 90deg could be explained by a smaller number of photoelectrons, which could be explained either by poor transmission of the 3-layer lens system or by poor reflectivity of the mirror, or both. We see in the document that the optical transmission through the 3-layer lens system seriously cuts the wavelength acceptance below 350nm. These are important Cherenkov photons.
- We also want to see the results from radiation tests of the lens material, including alternative materials in case that the NLak11 lens material does not work.
- Interaction with GLUEX is encouraged to see how the lens-based optics compares to the cylindrical mirror-based optics.
- The detector choice and its orientation in a magnetic field at 3T is also not solved yet.
- A detailed NIM paper with many pages by the end of the year would be welcomed.
- It is important to start getting experience with quartz bars.
- The committee would like to see future milestones for the next year of R&D presented at the next meeting.

MCP-PMTs

The RD14 Consortium has tested a commercial micro-channel plate PMT from Photek in magnetic fields and mapped out the loss of gain versus angle with respect to the field and determined how much of the gain loss could be recovered by increasing the bias voltages. As expected, the gain loss was least for fields perpendicular to the MCP-PMT and adequate gain could be maintained even at 5 Tesla by increasing the micro channel plate bias voltage. However, at 40 degrees, a 1 Tesla field is difficult to compensate for.

The collaboration plans to do detailed electron multiplication simulation studies and test additional MCP PMTs in the near future with the intent of identifying a readout device suitable for use with a DIRC in a high magnetic field. The committee notes that a simple simulation (or even calculation) should be able to predict the magnetic sensitivity reasonably well and that future tests should probably be restricted to devices with promising electron optics.

LAPPD Sensors

The gain of a 6x6 cm LAPPD sensor was tested in a 3T MRI solenoid. Timing was not tested, as the timing laser could not be used near the MRI solenoid. The gain tests showed that the LAPPD sensor has much less tolerance for operation in a magnetic field than either the Photek device mentioned above or a Photonis device tested by PANDA. The authors note that the greater internal spacing used in the LAPPD device will naturally make it significantly more sensitive to magnetic fields. Another version of the LAPPD is awaited to do additional testing. There is also a plan to study the radiation hardness of the device, for which the committee does not see the motivation. In addition there was a measurement of LAPPD sensitivity to rate. At gains of 10^5 the device seems to handle single photo-electron rates approaching $10^7/\text{cm}^2$ but at a more PMT like gain of 10^6 the gain begins to degrade at 10^4 spe per cm^2. Some of this rate sensitivity may be due to the internal divider chain, which could be further optimized in future versions. The collaboration notes that the LAPPD device was the only tested photo-sensor that did not show any significant magnetic attraction, which would be plus for constructing a supporting structure within a large magnetic field.

Unless there are significant changes in the underlying LAPPD design, it does not seem very high priority to continue the high field magnetic testing past the promised next prototype tests planned for this year.

TOF Detectors

The committee commends the collaboration on carrying out the beam tests at CERN in the COMPASS setup. The TOF performance and rate capabilities have been measured. A timing resolution of 25.4ps was achieved with a 36-gap RPC. This result is slightly worse than expected from cosmic ray studies. The RPCs were operated at a flux up to 80 Hz/cm^2 with an efficiency that increased with increasing rate, which is not understood. Another beam test at Fermilab is planned in the spring. The electronics for the readout is being revised to address some of its current limitations.

As noted in the previous report, the committee is concerned that a fundamental understanding of the multi-gap RPCs from first principles is not known, neither by the team, nor by the greater mRPC community. A simulation effort is just beginning. The group is strongly encouraged to understand the performance from first principles and be able to reproduce the results through simulations and this should receive highest priority.

The 3D printing approach, while novel and potentially cost saving, it seems premature to divert effort to this level of optimization. The signals presented were not understood. The group needs to first establish the basic technologies and detector configurations before moving to alternative fabrication methods.

eRD15: Compton Polarimetry

J. Hoskins reporting

The collaboration reported on the preparation of the simulation framework for the Compton polarimeter's electron detector in the EIC lattice. The GEMC framework using GEANT4 and developed for CLAS12 at JLab was employed. The design discussed includes a Compton chicane including beampipe. Testing of the simulation framework has begun, and manpower to pursue the effort has been identified and engaged. The collaboration is taking into account the significant difference in expected rates between the eRHIC and JLEIC designs. The collaborators have made contact with the CLAS12 SVT effort with their local wire-bonding expertise with a view towards future studies of timing response of possible detectors including diamond-based devices.

The Committee takes note of the planned contact with results from existing Compton polarimeters in operation, for example, at JLab and elsewhere. The collaboration plans a revised scattering chamber to enable in-beam tests of candidate detectors, their time response and their electronics.

The Committee looks forward to the next report where first simulation results are expected and to the resulting discussion of machine backgrounds and interfaces as well as to a discussion of radiation damage to any sensor and the power deposited in a detector and its infrastructure by backgrounds. An interesting discussion would address required amount of shielding and any limitations on laser power and thus counting rate that may result, and the effect on measurement strategy, time and precision. Continued contact with the accelerator groups developing the two machine reference designs is encouraged.

eRD16: MAPS for the EIC

E. Sichtermann reporting

As noted in July 2015, the committee was pleased to see an area of study, in the EIC detector development community, emerge, with a focus on silicon-based tracking. A number of comments and recommendation were made at that time, and reconsidered below in italics. The committee notes that the start-up of this activity has been slowed by logistical and funding issues, which now seem to be resolved or improved. The committee also notes that the host laboratory, LBNL, has recently identified the EIC as a focus for near term strategic support. The committee encourages the collaboration to consider this opportunity. The collaboration could choose to look broadly at the needs and opportunities for further development of MAPS and the related infrastructure across the range of activities from simulation through mechanics, cooling, electronics, and sensor development.
Suggest noting here that the italics are the prior report from July 2015 and the following text is the update based on this report. Those at the closeout will know this but I expect others to see the report.

1) *From the July 2015 report: "At the time of the next EIC meeting a basic conceptual layout of a forward tracker is expected, as discussed during the meeting"*
   A conceptual layout was shown in the slides

2) *From the July 2015 report: "Aluminum conductors are well motivated by the needs to reduce mass. Due to the risks and difficult past experience with this technology the proponents are urged to consider fallback solutions carefully. In the forward direction perhaps the additional space for service routing allows more flexibility to use also traditional copper based conductors? The committee also asks if the need for via connections between Aluminum layers can be avoided. A simpler structure with metal layers, which are only interconnected by wirebonds, could be a more conservative approach, which still provides the needed electrical characteristics and performance."*
   Progress was shown on the baseline aluminum solution with vias. The fallbacks remain still to be considered in more depth. The basic concerns with aluminum still remain in place as a viable solution in a production mode.

3) *From the July 2015 report: "The area of MAPS type sensor/electronics is expanding considerably with the work in the HEP community in HV-CMOS and High Resistivity (HR)-CMOS. Following these developments carefully is strongly recommended and developing an understanding whether any of these would become options for the EIC as well. As work and interest in precision tracking for EIC develops furthering any combined efforts with HEP would be to everyone's benefit."*
   This item remains open and still to be considered. Particularly considering synergistic activities in the broader HEP community, and at LBNL, and the new strategic aspect at LBNL, the committee strongly re-recommends an evaluation of HV/HR-CMOS and existing MAPS to understand, what if any, emerging approaches may be relevant to this R&D.

4) *From the July 2015 report: "It is noted that the Compton Polarimeter also requires a small electron tracker in the forward direction. The readout speed requirements are higher there. Nonetheless, there may be ideas and approaches, which could be applicable to both the Polarimeter and the F/B tracking station. The committee hopes the two communities will establish contact. Similarly we hope a good contact and dialogue will be established with the eRD6 / eRD3 Tracking consortia."*
   No indication that this was explored yet.

Recommendation: The committee strongly encourages the collaboration to follow up on its recommendation as updated here.

eRD17: DPMJETHybrid 2.0

M. Baker reporting

In order to ensure that the detectors designed for the EIC fully address the physics program it is important to incorporate models that include all relevant physics in the Monte Carlo simulation. Nuclear shadowing / parton saturation effects are currently not included in the suite of eA DIS event generators available for EIC physics simulations. The eA event generator DPMJetHybrid is being extended to include these effects.

This is a new project, and due to the partial funding of the proposal, the project start date was changed to January 4, 2016. Over the past six months in anticipation of project start, the proponents have actively engaged with the community and the DPMJetHybrid 2.0 initiative has received an encouraging response.

The results of a related, but separate, project were also reported. Using ZEUS data, Pythia-6, a key-component of DPMJetHybrid, was tuned to better describe the longitudinal distribution of forward particle production in ep collisions, a necessary ingredient for describing forward particle production in eA collisions.

LoI: Developing Analysis Tools and Techniques for the EIC

Markus Diefenthaler reporting

A Letter of Intent was presented for an EIC consortium on the development of a suite of analysis tools and techniques for the EIC. The scope of the consortium is the development of full Monte Carlo simulation including event generators, detector geometry and response and pattern recognition in and between detector subsystems allowing the study and development of analysis tools and techniques for a broad EIC physics program. An initial workshop was held in September 2015 to review the EIC software status with a focus on detector and physics simulations to identify interfaces between the existing BNL and JLab software. In particular the group proposes to focus on providing an interface between the various simulation frameworks and develop a geometry interface.

Crucial for any experiment is a seamless integration of the various analysis tools, such as the tracking software, calorimeter clustering and jet finding and other simulation and analysis tools. Under the aegis of the proposed consortium these tools and techniques would be developed and integrated with the existing simulation tools and their future compatibility would be ensured.

The committee welcomes this initiative and agrees that a robust software environment, compatible with the existing software frameworks, is very important for the development of the physics case for the EIC. The emphasis of the proposed consortium is in the area of Monte Carlo developments and creating compatible interface tools. It is suggested that the proponents reevaluate their strategy and consider a long-term perspective in the development of the basic infrastructure in terms of geometry definition, i/o interface and analysis tools, that guarantees its long-term value to the community and ultimately becomes the framework used in the experiments at an EIC.